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# 6.8 Human Land Use and Flood Risk

Human land use is directly linked to flood risk and salmon habitat degradation. The economic benefits derived from human land uses are often the primary obstacles to making changes in the policies and practices of floodplain management. This section includes assessments of land ownership and use, stream crossings and diversions, water quality, dikes and levees, and flood damage claims and permits.

### 6.8.1 Floodplain Land Use and Development

#### ■ Objectives

The extent and type of flood hazards are a reflection of the characteristics of land use occurring within floodplain lands. The objective of the floodplain land use assessment was to characterize the types of human land uses occurring within the regulatory 100-year floodplain in the Tillamook Bay lowland valley areas. Land uses within the floodplain can be linked to flood damage claims and permits and to the policies and programs affecting floodplain development and flood risk mitigation. Understanding the distribution and quantity of land in various uses helps to define management strategies and to identify and prioritize courses of action.

#### ■ Methods

Current Tillamook Bay lowland land use GIS data was obtained from the TBNEP. These data were sorted into the following general land use categories: agriculture, farm buildings, rural residential, rural industrial, and urban. The coverage was then clipped to the extent of the FEMA Q3 100-year floodplain. A detail of the floodplain around Tillamook is mapped in Figure 6-8-1. The coverage provides a summary of the acreage of different land use types within the 100-year floodplain of the Tillamook Bay. The resulting land use acreages are presented in a pie chart (Figure 6-8-2).

#### ■ Discussion

As expected, agriculture is the predominant land use type within the lowland valley areas. Agriculture in the basin is primarily associated with Tillamook's dairy industry, so most of the agricultural land is used as pasture. Flood risk in this area is primarily livestock health and loss of access to grazing land. Strategies that facilitate post-flood drainage will provide great benefits in this area. This land use includes farm buildings, which represent the smallest land use acreage in the 100-year floodplain. Some of these areas correspond to confined animal feeding operations (CAFOs). These may pose a serious threat to human health and aquatic habitat when exposed to flood water.

There is some rural residential development in the basin. It is clustered along the roads and rivers and may indicate increased damage claim amounts following flood events. Rural industrial use in the basin is primarily gravel extraction and is also clustered along the rivers. Management of these uses should be considered and prioritized based on the intensity of the industrial use versus that of other land uses that cover a greater area of the floodplain.

Urban land use is the second most extensive use in the 100-year floodplain. A large portion of this use is along Highway 101 north of the city of Tillamook. Though the acreage in agricultural use within the 100-year floodplain is twice that of the acreage in urban use, the value per acre of urban land is substantially higher than that of pasture land. This is especially true in Oregon where land use planning confines urban development to urban growth areas. There is, therefore, an increased likelihood of higher damage claims in the urban areas, so efforts to reduce flood risk in urban areas will have a greater overall effect on reducing the total amount spent on damages. Conversely, the relatively small area and short length of stream channels inside urban areas may limit the benefit to salmon created through floodplain management efforts in urban settings. The longer contiguous reaches of river on agricultural lands presents greater opportunities from an aquatic habitat perspective.

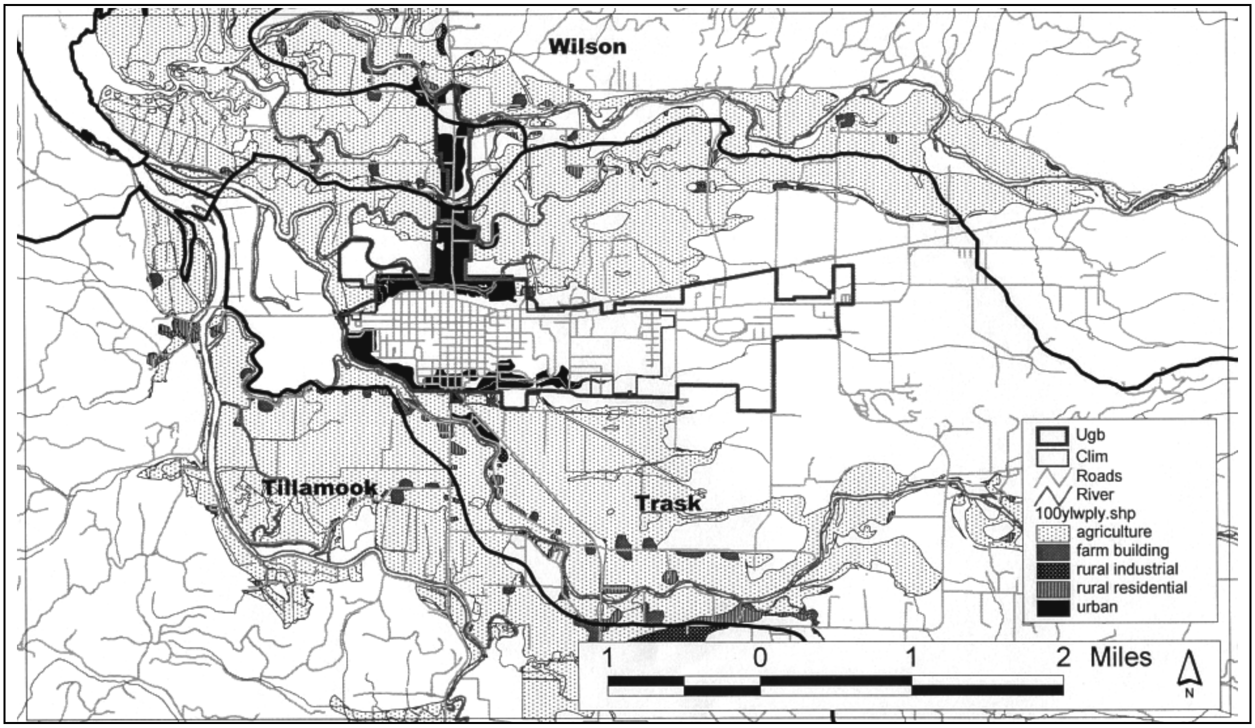


**Figure 6-8-1. Generalized Land Use within the FEMA 100-Year Floodplain**

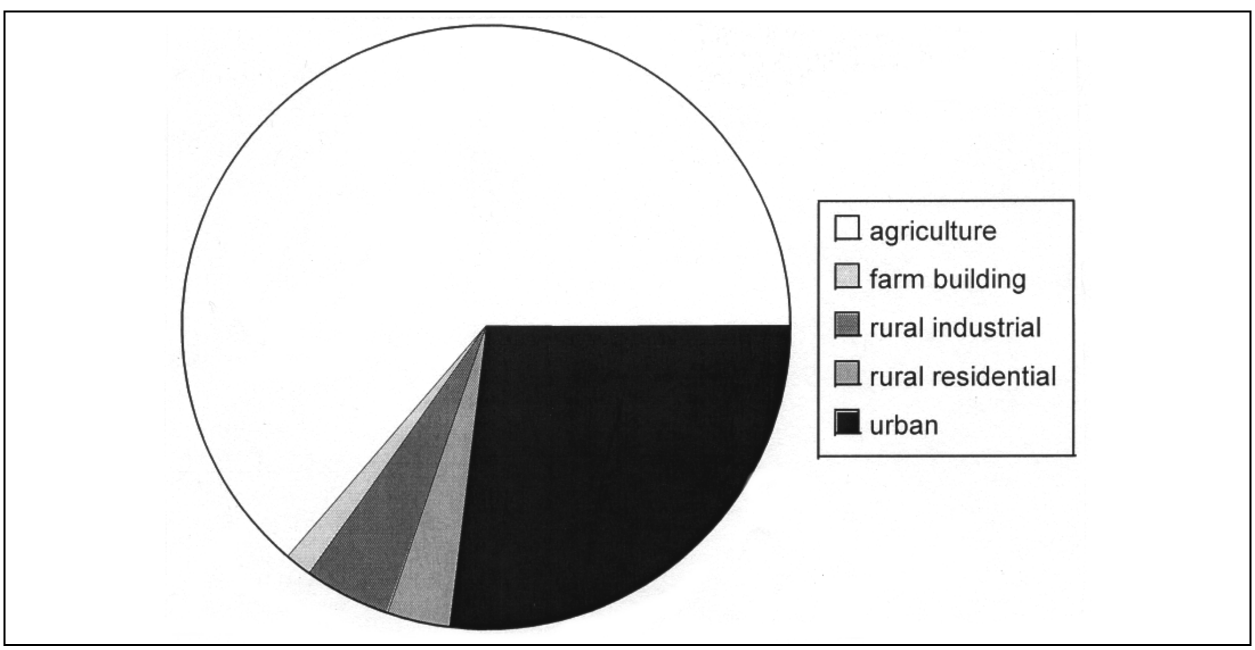


**Figure 6-8-2. FEMA 100-Year Floodplain Land Use**

### 6.8.2 Stream Crossings

#### ■ Objectives

The linear characteristics of roads and railroads often result in stream crossings. Traditionally, the most economical method employed for conveying streamflow through a crossing was with the use of a culvert and an earth fill embankment. This technique often restricts the cross-sectional area of a stream and causes changes in flow velocity, leading to unnatural erosion and deposition patterns in the stream, locally and upstream and/or downstream. In many cases, a pool and drop will form downstream of the culvert because of these conditions, creating a barrier to salmon passage, or flow will be concentrated in the culvert and water velocities will be too high for salmon to swim against. Culverts also perform poorly in flood events and can be washed out at high flows, causing localized landslides, especially in steeper sloped upland areas. The objective of this assessment was to identify the location and distribution of stream crossings in the Tillamook Basin and lowlands and evaluate their importance in a river management strategy.

#### ■ Methods

A GIS coverage of culvert locations in the Tillamook Basin was obtained from the TBNEP (Figure 6-8-3). The coverage was created by TBNEP for ODFW and maps all culverts in the Tillamook Basin that are assumed fish barriers. Additional culverts are known to exist within the basin uplands and are associated with state and private forestry roads. These data are being prepared by the Oregon Department of Forestry (ODF); however, they were not yet available during the course of this investigation. The basin mapping is enlarged to show culverts and tide gates in the Tillamook lowlands (Figure 6-8-4).

#### ■ Discussion

Since culverts are primarily associated with roadways, the heaviest concentration of stream crossings is in the lowlands and the low elevation uplands (Figure 6-8-3). The Trask, Tillamook and Miami River subbasins have culverts distributed throughout their areas. The Kilchis subbasin has relatively fewer culverts in headwater areas, as does the middle portion of the Wilson subbasin. Salmon recovery efforts may be most viable in portions of the basin where these upland interventions in the river system are few, because natural processes may be relatively intact and salmon passage may be available for a wider range of seasonal streamflows. Where single ownership of large land parcels (and associated culverts) exists in upland sub-watersheds coordinated efforts to improve stream crossings may be more feasible than if multiple land owners are involved.

The dispersed locations of culverts and tide gates in the lowlands (Figure 6-8-4) represents a patchwork of flood control structures that modifies and complicates the natural flow of the tides and streamflows in the lowlands. Unforeseen circumstances, such as debris blockages after flood events, may create localized maintenance problems and lead to unintended consequences in the operation of the gates. Tide gated diversion structures or backwaters may also strand and kill fish that enter and cannot get out, and die as the side channels dry out (or get washed into fields). A system-wide effort to retrofit or remove these structures could reduce regional flood risk and restore large contiguous areas of habitat, but may be hindered by multiple ownership of the structures.

Culverts and tide gates are some of the more intrusive elements in a river system because they directly and significantly alter sediment and water flow patterns, leading to morphological changes and fish passage barriers. Since the physical effects of a culvert may impact large reaches of a river and upstream fish distributions, modification or removal of these structures should be prioritized to restore natural processes and fish access to restored river reaches.

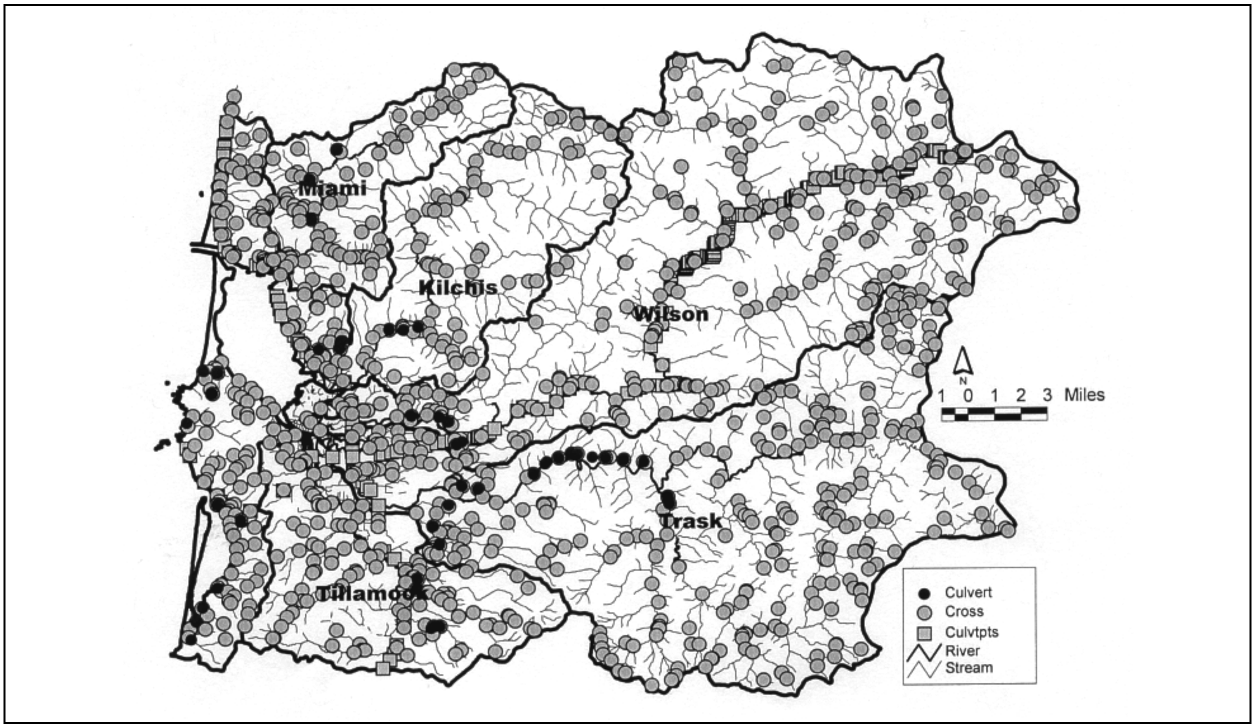


**Figure 6-8-3. Basin Stream and River Crossings by Source**

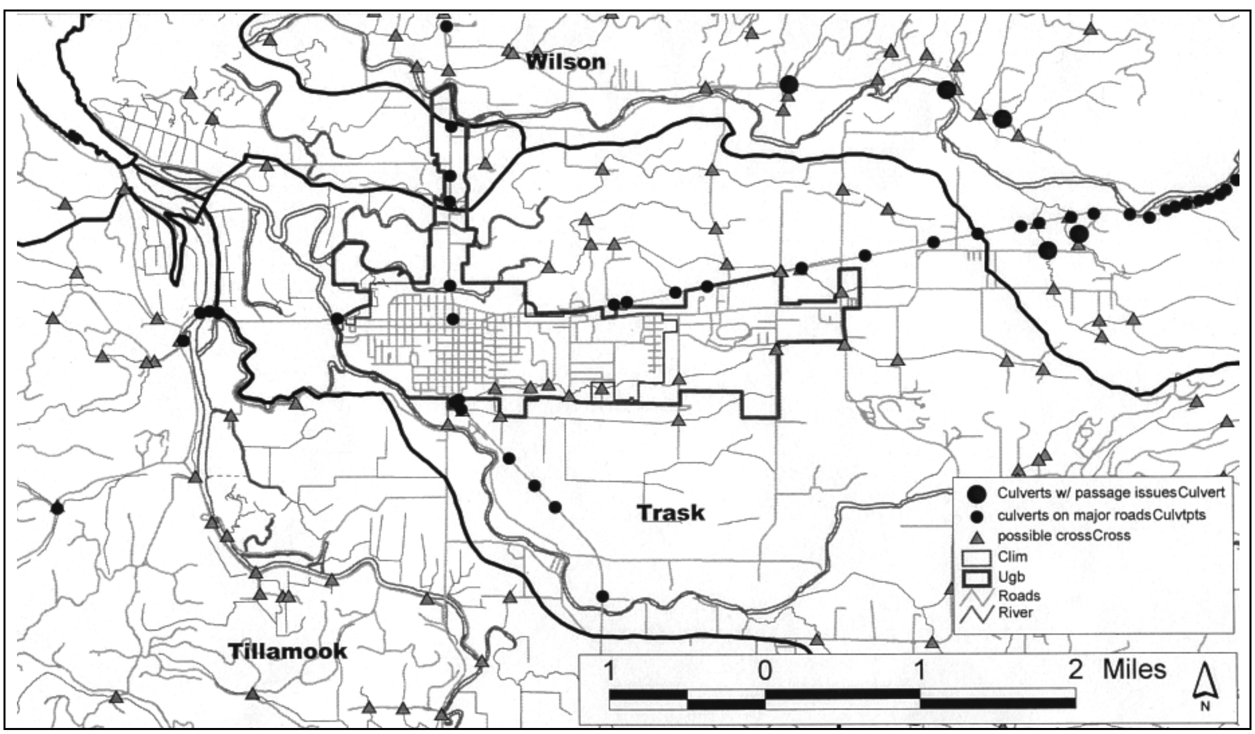


**Figure 6-8-4. Tillamook Lowland Valley Stream and River Crossings**

### 6.8.3 Dikes and Levees

#### ■ Objectives

The construction of dikes and levees is associated with a number of impacts affecting both aquatic habitat and flood risk. The objective of this assessment was to better understand the impacts of levees and dikes in the Tillamook Bay Basin estuary. Levee locations, when combined with information on native vegetation and channel planform, will help to develop and prioritize management strategies for the lowland estuary area.

#### ■ Methods

Two sets of available dike and levee GIS data for the Tillamook Bay Basin were obtained. One was created by the TBNEP and the other by the Corps. The Corps' data includes a subset of the levees mapped by TBNEP, but they are mapped with greater accuracy. A new levee coverage, LEVEEMO, was created by augmenting these coverages with information from USGS topo quads. This data coverage includes the levees from the Corps coverage and the levees and roads mapped on USGS topo quads (Figure 6-8-5). Roads were included because they are often built on elevated roadways and, though not labeled as levees on maps, often have the same effects on the movement of water. This new levee coverage was mapped along with historic vegetation and current wetland vegetation (Figure 6-8-6) to illustrate the relationship between levees and changes in vegetative cover.

#### ■ Discussion

Many of the dikes and levees in the Tillamook Bay Basin are located below the MHHW elevation in the estuary. Levees are often used in conjunction with drainage tiles to improve agricultural productivity in tidally influenced areas by protecting land from salt water. Separated from tidal action and exposed to land drainage and grazing, native plant communities were replaced, over time, by non-native communities. Interestingly, some of the vegetation has reverted to its historic community structure. This has likely occurred in areas where the levees were not maintained the reintroduction of salt water inundation was allowed.

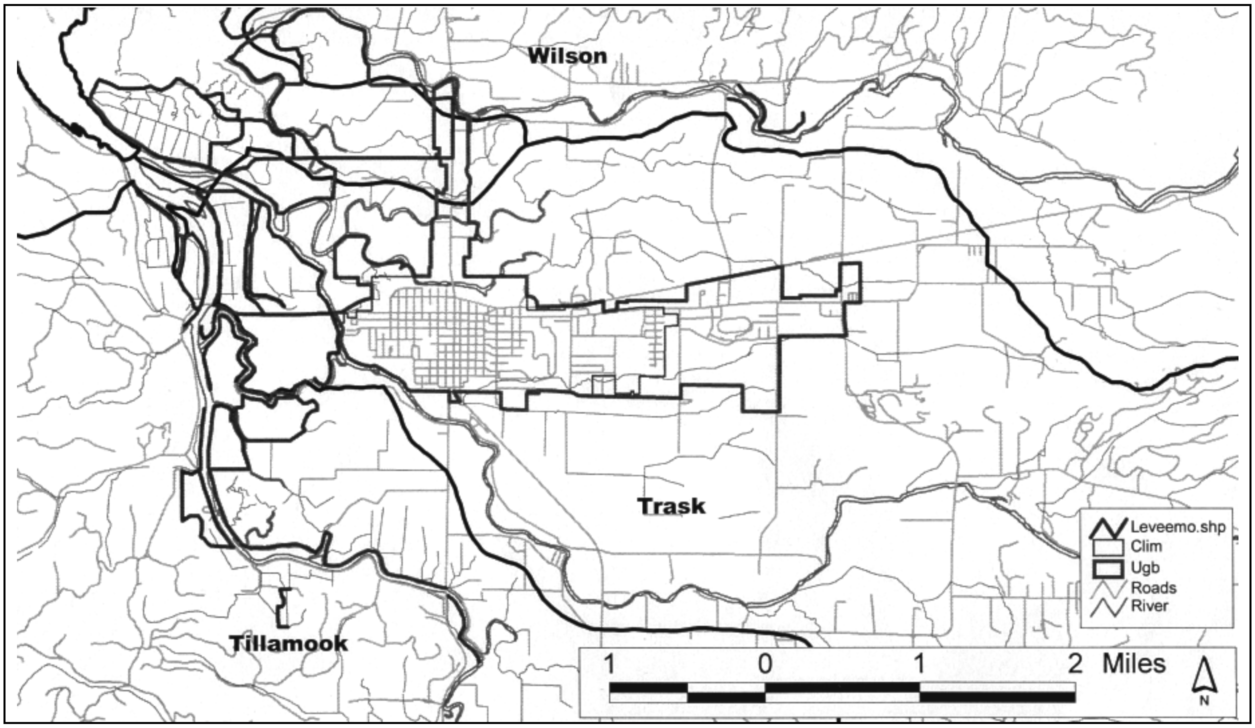


**Figure 6-8-5. Lowland Valley Levees and Dikes**

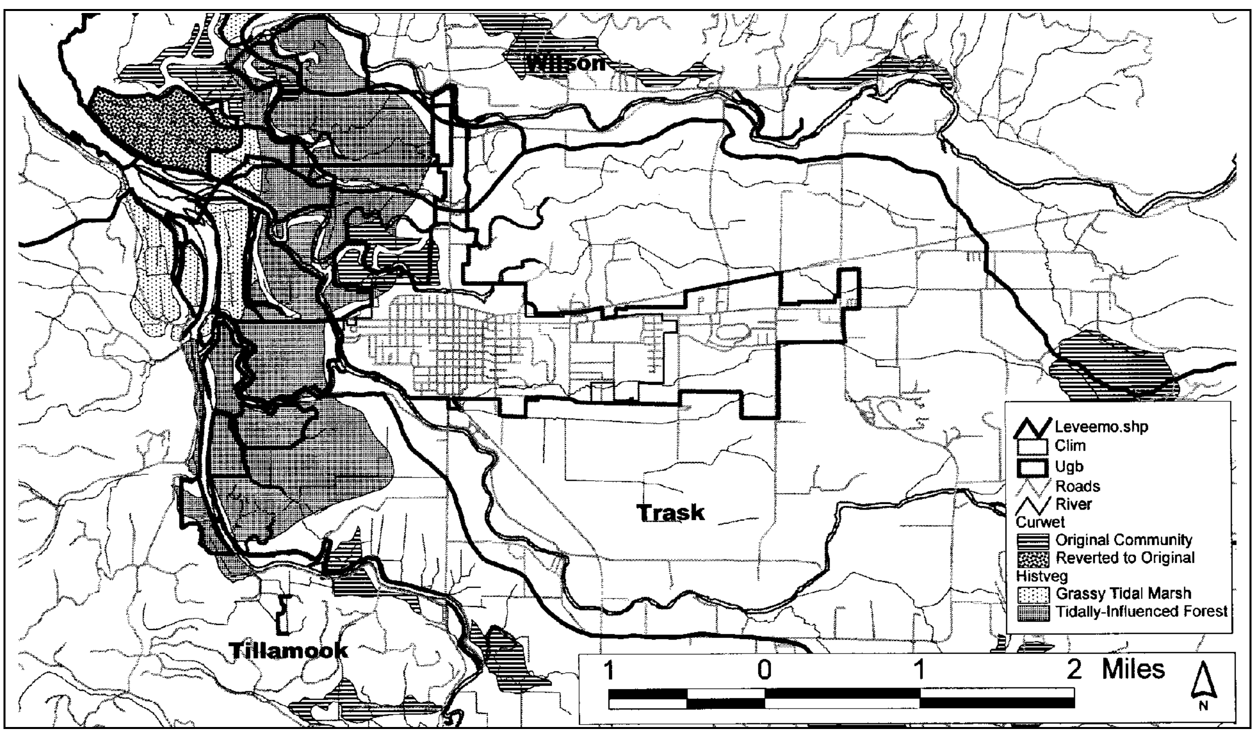


**Figure 6-8-6. Levees and Dikes Mapped with Historic and Current Tidal Plant Communities**

### 6.8.4 Post-Flood Permit and Damage Claims

#### ■ Objectives

Increasing development in flood-prone areas, combined with repetitive flood events, have resulted in an increasing number of flood damages and permit requests for waterway work following floods. These post-flood actions often hinder habitat restoration efforts or increase flood risks to neighboring properties. The objective of this assessment was to understand the characteristics of flood damage claims and permit requests in Tillamook County, to determine how permit actions are approved, tracked and archived and to assess how well the permit database information reflects the actual permitting of post flood actions. Based on the findings of this assessment, recommendations are made for streamlining the permit system and improving the accuracy and usefulness of permit data.

#### ■ Methods

Tillamook County flood damage estimates, damages claims and flood insurance data were evaluated from a comprehensive report on flood problems in the county (Levesque, 1980) and from interviews with FEMA Region X staff (Eberlein, 1997). Historic flood damage data were compiled and compared on a common basis using 1996 dollars (Table 6-81). Damage estimates were converted to 1996 dollars by multiplying earlier dollar amounts by a ratio of the respective MEANS Historical Cost Indexes (MEANS, 1997). Flood insurance policies and coverage amounts for 1980 (Levesque, 1980) were compared to those for 1997 (Eberlein, 1997) by local jurisdiction (Table 6-8-2). Claims amounts since 1978 were also itemized by local jurisdiction.

Post-flood permits were evaluated from agency databases including: the U.S. Fish & Wildlife Service (USFWS), the Federal Emergency Management Agency (FEMA), the Corps of Engineers (COE), the Natural Resource Conservation Service (NRCS), and the Oregon Division of State Lands (DSL). Data were obtained directly from permit and database staff through interviews. Permit application forms and data entry practices were compared among the agency databases, and the accuracy of the entries was assessed. The computer hardware and software used for the databases was identified, and the portability of data among agency databases and to PC-based computing systems was assessed. The accuracy and usefulness of the data for quantitative analysis using GIS was evaluated by plotting raw agency data and observing resulting permit locations on maps.

#### ■ Discussion

A comparison of 1996 flood damages to historic flood damages indicates the 1996 event was significantly the most damaging event in the history of the county (Table 6-8-1). Flood insurance policies have more than tripled in Tillamook County between 1980 and 1997, and insurance coverage has increased by nine times to $122 million (Table 6-8-2). The increase in flood insurance policies may be an indication of increasing development in flood hazard areas.

Several agency permit databases exist because of the variation in the jurisdictions of the agencies. For instance, the FEMA database lists actions not in waters of the United States and thus not permitted and recorded by COE or DSL. A compilation of 1996 permit and claim locations in the Tillamook Bay Basin is shown in Figure 6-8-7 for FEMA actions and COE and NRCS permits. Data for this year was loosely assumed to reflect permits and claims related to the February 1996 flood event. Numerous post-flood permits were applied for in Tillamook County. In the Tillamook Bay Basin, these projects tended to be concentrated along the margins of the bay and in the

**Table 6-8-1. Comparison of Tillamook County Historic Flood Damages in 1996 Dollars**

| Flood Year [1] | Flood Damages [1] | Historic Cost Index [2] | Flood Damages (1996 $)[3] |
|---|---|---|---|
| 1964-65 | $1,632,000 | 21.2 | $8,337,057 |
| 1972 | $3,303,000 | 34.8 | $10,279,164 |
| 1974 | $310,000 | 41.4 | $810,942 |
| 1977 | $4,213,000 | 49.5 | $9,217,533 |
| 1996 | $53,000,000 | 108.3 | $53,000,000 |

[1] From Levesque, 1980

[2] From MEANS, 1997

[3] Example 1996 $ = 1974 $ x (1996 index/1974 index

**Table 6-8-2. Comparison of Tillamook County Flood Insurance Coverages Between 1980 and 1997 and Claims Since 1978**

| Area | No of Policies (in 1980) | Insurance Coverage (1980$) | No of Policies (in 1997) | Insurance Coverage (1997$) | Claims Since 1978 (1997 $) |
|---|---|---|---|---|---|
| Tillamook County | 235 | $9,393,700 | 766 | $80,470,600 | $1,416,161 |
| City of Tillamook | 15 | $451,500 | 91 | $10,623,100 | $1,451,185 |
| City of Bay City | 6 | $176,600 | 8 | $722,100 | $0 |
| City of Garibaldi | 0 | $0 | 2 | $693,000 | $0 |
| City of Manzanita | 15 | $572,500 | 47 | $7,889,000 | $1,954 |
| City of Nehalem | 11 | $556,600 | 27 | $3,184,300 | $190,881 |
| City of Rockaway | 50 | $1,960,100 | 155 | $17,281,700 | $48,777 |
| City of Wheeler | 3 | $44,900 | 3 | $685,300 | $0 |
| **TOTALS** | **335** | **$13,155,900** | **1099** | **$121,549,100** | **$3,108,958** |

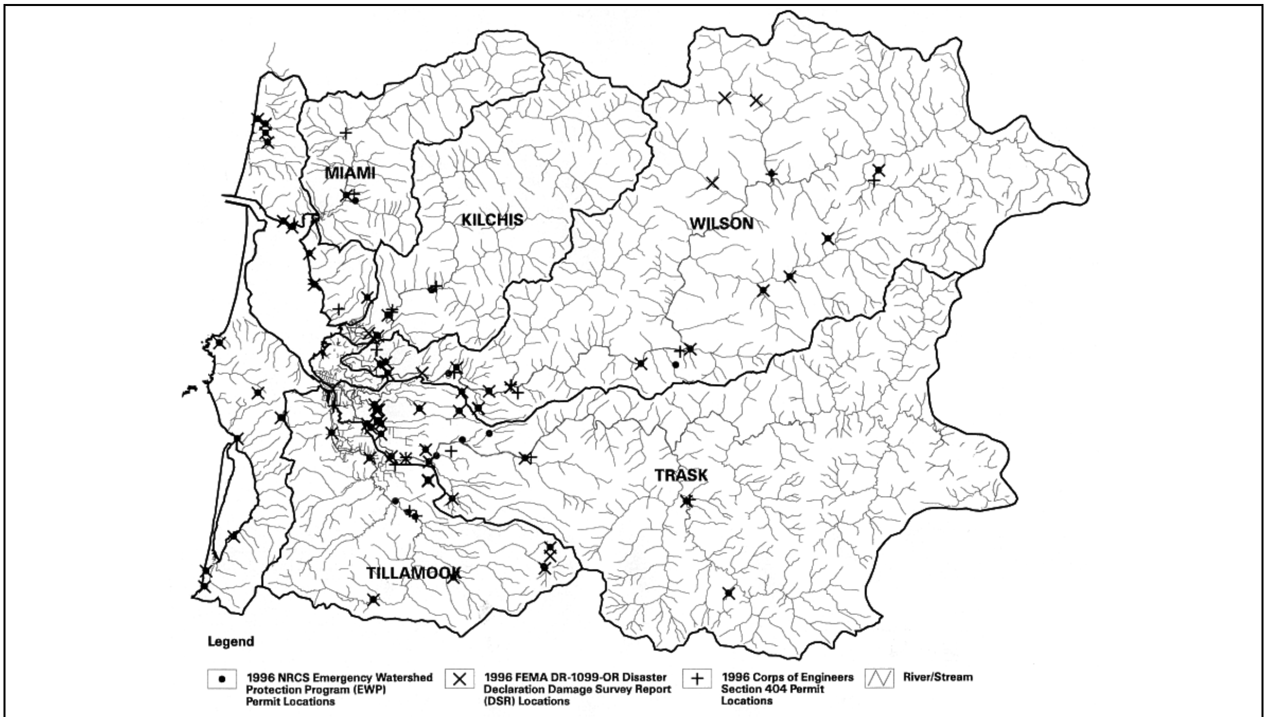


**Figure 6-8-7. 1996 Permits and Flood Damage Claims**

City of Tillamook and the Wilson River floodplain. Efforts should be made to coordinate or consolidate databases to enable consistency and efficiency in the permit process. The complexity of evaluating cumulative impacts is one of the major reasons why coordination of databases is needed, between agencies which regulate waterway impacts, agencies which evaluate water quality, and agencies responsible for fish and wildlife resources.

Different agencies use different database hardware and software. For instance, USFWS uses Paradox while DSL has used Wang. An agency which does not have Wang cannot access the DSL database unless DSL converts the requested information into a different format, such as an EXCEL spreadsheet. The COE RAMS database is not transferrable to file at all, and can only be used on screen or in print-outs. The NRCS uses a form of spreadsheet which USFWS programs have not been able to import. In many instances, federal agency computing systems were established many years ago, and large databases are still being managed on old mainframe systems, as opposed to PC-based systems that are compatible with microcomputer applications and GIS systems.

In instances where there is a compatible database structure, it is difficult to exchange data because of differing database content. For instance, NRCS does not provide applicant names in public copies of the database, and does not include COE or DSL permit numbers. Therefore, it is difficult to match these records. Some of the databases lack detailed information about actions. The COE database contains latitude and longitude for each action, but not the size of the action. The DSL database records the size of the action, but not its latitude and longitude. It is understood that DSL gave up the lat/long system with consideration of private property rights. A standardized method should be followed by all agencies to record similar data, especially in a format that can be transferred to microcomputers and GIS.

Databases for quantitative analysis should have separate fields for each type of information and should have clear and consistent naming conventions. For instance: River, County, Latitude, and Longitude should be separate fields, rather than having one field for Location. This way, information which is needed for the purpose can be easily isolated, and extraneous information ignored. When information is not thoroughly divided into specific fields, querying also becomes difficult and less useful. Again, a consistent format or one central database would eliminate repetition of data entries and the inability to cross reference data among agencies.

Discrepancies also exist between actual actions and their recorded descriptions. For instance, an applicant is likely to use a different amount of riprap than what was requested in the permit application and permitted. The DSL database has fields for both permitted and completed amounts of fill and removal, but there is virtually no data entered in the 'completed' field. The regulatory program should be expanded to require documentation of the resulting 'as-built' condition, possibly through the use of economic incentives for the permit applicant.

From the databases, it is difficult to study the repetitive damages from flooding. Some databases, such as that of DSL, go back several decades but contain limited information on repeated actions. For instance, it is not evident how many times the same gravel removal permit had been renewed. Other databases only contain records since 1991 (COE) or 1996 (NRCS) because of programmatic changes. Permit databases should be structured in a manner that allows an assessment of repetitive actions and the cumulative impacts of these actions.

A number of problems in the existing databases can impede efforts to create a GIS map which emphasizes the biological significance of actions. DSL's use of section, township, and range results in permit actions being plotted at the center of a section, and not necessarily even appearing associated with any stream. Even with latitude and longitude data, many actions appear to overlap. Another location method used is river miles. These data could be helpful to correlate flood response actions with fish habitat. However, plotting river miles requires that they be measured from the mouth of every stream, and every stream has a River Mile 0, for example. This is in contrast to a more precise measurement such as latitude, which signifies a specific point on the globe. Preparing data for GIS or other forms of analysis is extremely time-consuming and complicated, perhaps needlessly so. A close working connection should exist between field staff, database staff, GIS staff, and project managers so that products can be evaluated at every step of the process and work can proceed efficiently.

The nationwide permit process, under which almost all bank stabilization projects are authorized by the COE, is meant to speed the construction of projects which have minimal environmental impacts, individually and cumulatively. In Tillamook County, 97 percent of the Nationwide Permits issued between 1988 and 1996, during the designated flood disasters of 1990 and 1996, were approved. Whether cumulative impacts are minimal is especially difficult to evaluate for river projects because habitat and habitat impacts are not quantified in acreage as wetland losses are. Under the nationwide permit process, not all post-flood actions which occur receive permits. Rural areas are especially likely to have large waterway impacts that go unnoticed by regulatory agencies. The nationwide permit process should be reviewed to assess the criteria for permit approval, the implications of the process on cumulative effects, and the opportunities for using data from the process to evaluate cumulative effects.

### 6.8.5 Public Policy Assessment

#### ▪ Objectives

The intent of the public policy component of the Tillamook Integrated River Management Strategy (IRMS) is to develop the context in which to implement the three underlying objectives:

- restoration of floodplain functionality
- reduction of flood impacts
- improvement of aquatic and terrestrial habitat

The scope of the public policy assessment was originally intended to review all plans and government-administered activities which impact the three main objectives. The focus was fairly clear as to the limited number of polices which potentially impacted these objectives. However, soon after the review of the target policies and programs began, it became clear that the specific items as mentioned were not the crux of the key issues. For example, the Goal 7 update process is not only significantly behind schedule, but its scope is also being modified. Another example is the Oregon Plan, which relies heavily on current permitting and review processes.

Thus, after a preliminary review of key policies, it was determined that the first step must be an inventory of policies currently in effect for the study area. The term 'public policy' was broadly defined to include a wide range of activities to accomplish such tasks as:

- problem identification (hazard analysis, water quality degradation, etc.)
- data analysis (GIS based inventories, etc.)
- development of planning goals (CZM project, NEP, etc.)
- adoption of plans (county plans, Oregon Plan, etc.)
- adoption of regulations and permits (404, 402, building permits, etc.)

After defining the scope to cover all of the above types of "policies" it became clear that the array of policies and permits in the generalized area encompassed by the IRMS is vast. Most, however, do not explicitly address the floodplain, and do not necessarily explicitly address the IRMS goals. Nonetheless, each policy has important impacts on the areas of concern of the three original objectives. Conversely, tools which are in effect have not been structured to implement the key objectives, e.g. NEPA. Finally, major efforts in effect for our study area are only indirectly impacting the actual public policies, e.g. NEP, but such projects do not explicitly promote implementation because they have no legally binding status.

#### ▪ Methods

Since the public policy assessment was intended to clarify the complex federal, state and local policy environment, an initial effort was made to inventory the 54 programs impacting the IRMS. The inventory was prepared in spreadsheet format (Table 6-8-3) in order that entries could be accessed and sorted into seven categories:

1. **Level.** Programs promulgated at federal, state, and local levels were identified.
2. **Responsible Agency.** The specific agency within the federal, state or local levels were identified.
3. **Spatial (geographic scope)**. The spatial scope of the each policy was defined (surface waters, flood plain etc.). In many cases the spatial context of the policy has not been explicitly defined, i.e. the polices were aspatial as written; however as they become implemented they impact a specific spatial area, e.g. Tillamook basin.
4. **Purpose.** Underlying intent of the program.
5. **Program Authority**. Policies adopted by law have legal/implementation authority, while plans tend to be advisory where

implementation is discretionary. In general, laws and regulations are promulgated at the federal level. They are, however, administered at the state level, and are in many cases implemented at the local level.

6. **Trigger Activity**. In many cases an action results in the requirement for compliance with specific programs or regulations, i.e. they will trigger the need for a permit. An emphasis of this inventory has been on the legal context of requirements.

7. **Key Issues.** Key issues were defined in relation to concerns of the IRMS primary objectives. The issues and the number of policies reviewed in each category are listed below:

   (4) Access/NEPA
   (11) Flood Hazard Reduction
   (2) Floodplain Management
   (14) Water quality
   (8) Watershed Planning
   (10) Habitat
   (1) Land use planning
   (1) Terrain analysis
   (2) Water availability

## ■ Discussion

Review of the accompanying inventory leads to a number of conclusions.

1. **Policy is highly fragmented.** Broad investigative actions are initiated at the federal level. Authority for review is at the state level; while administration of permit granting and decision making is at the local level. Although 54 separate policy items were reviewed, the inventory is dramatically incomplete and does not give a holistic view of the planning status for the area.

2. **Policies are generally advisory, while permit requirements are legal tools and are only tangentially related to polices.** The most comprehensive planning programs do not have the status of law e.g. NEP, CZM. Conversely, existing permit authorities are currently being used to achieve objectives significantly different than the underlying intent of the permitting authority.

3. **Disconnect exists between plans and regulations.** There appears to be a continuity gap between plans and regulations. The most prevalent forms of permits pertain to fill and dredging. The intent of the these permits does not correspond to any of the three objectives, yet they have the most significant impact on the geographic/spatial area (integrated river system) under study.

GIS data sets being developed by various planning efforts do not necessarily support planning or regulatory need which would facilitate the three policy objectives.

Future efforts should be made to complete this document by reviewing the existing implementation profiles (including 404 and other permits) in light of both their original intent and current planning goals e.g. Essential Fish Habitat goals. The underlying objective should be to ascertain whether the existing permit structure needs to be modified in light of current concerns. Related efforts should look at flood control efforts such as diking practices and removal-fill agreements in light of current ESA and related issues.

**Table 6-8-3. Inventory of Public Policies Influencing Resource Management in Oregon and Tillamook**